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Document title: Application module for Feature



**ABSTRACT:**

Establishment of neutral assembly model within STEP is quite important and urgent issue from various application viewpoints, such as parametric assembly, assembly/disassembly process planning, kinematic analysis, and tolerance analysis. Features and their association plays a key role to represent the association among the assembled components. This document is the draft technical specification of an application module for the features and their associations as a base of the features needed to represent the assembly model.

**KEYWORDS:**
feature, feature association

**COMMENTS TO READER**:
The contents of this document is a restructured part of ISO TC 184/SC 4/WG 12 N 597 JNC proposal of assembly model for products, aiming at developing a set of application modules for representing the assembled products.

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# Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards in normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

The main task of the technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75% of the member bodies casting a vote.

In other circumstances, particularly when there is an urgent market requirement for such documents, a technical committee may decide to publish other types of normative document:

- an ISO Publicity Available Specification (ISO/PAS) represents an agreement between technical experts in an ISO working group and is accepted for publication if it is approved by more than 50% of the members of the parent committee casting a vote;

- an ISO Technical Specification (ISO/TS) represents an agreement between the members of a technical committee and is accepted for publication if it is approved by 2/3 of the members of the committee casting a vote;

An ISO/PAS or ISO/TS is reviewed every three years with a view to deciding whether it can be transformed into an International Standard.

This International Standard is organized as a series of parts, each published separately. This part of ISO 10303 falls into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, application test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. The complete list of parts of ISO 10303 is available from the Internet:

< http://www.nist.gov/sc4/editing/step/titles/ >

Annexes A and B form an integral part of this part of ISO 10303. Annexes C, D and E are information only.

# Introduction

ISO 10303 is an International Standard for the computer-interpretable representation and exchange of product data. The objective is to provide a neutral mechanism capable of describing product data throughout the life cycle of a product independent from any particular system. The nature of this description makes it suitable not only for neutral file exchange, but also as a basis for implementing and sharing product databases and archiving.

This International Standard is organized as a series of parts, each published separately. This part of ISO 10303 falls into one of the following series: description methods, integrated resources, application interpreted constructs, application protocols, application test suites, implementation methods, and conformance testing. The series are described in ISO 10303-1. This part of ISO 10303 is a member of the application module series.

This part of ISO 10303 specifies an application module for features. This part of the ISO 10303 provides for the definitions of the class of features and how these structures relate to product data, but does not include detailed definition of items of features.

# Industrial automation systems and integration –

# Product data representation and exchange –

# Part 10xx:

# Application module: features

## 1. Scope

This part of ISO 10303 specifies the application module for feature in order to describe the associations among the components of an assembled product.

The followings are within the scope of this part of ISO 10303.

- the representation of features of the components;
- the representation of association of features;

The following are outside of the scope of this part of ISO 10303

- detailed definition of features;

## 2. Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 10303. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 10303 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 8824-1:1994, *Information technology – Open system interconnection – Abstract syntax notation one (ASN.1) – Part 1: Specification of basic notation*.
ISO 10303-1: 1994, *Industrial automation systems and integration – Product data representation and exchange – Part 1: Overview and fundamental principles*.

ISO 10303-11: 1994, *Industrial automation systems and integration – Product data representation and exchange – Part 11:Description methods: The EXPRESS language reference manual*.
ISO 10303-41: [1)], *Industrial automation systems and integration – Product data representation and exchange – Part 41: Integrated generic resource: Fundamentals of product description and support*.

[1)] To be published
ISO 10303-42: [1)], *Industrial automation systems and integration – Product data representation and exchange – Part 42: Integrated generic resource: Geometric and topological representation*.
ISO 10303-43: [1)], *Industrial automation systems and integration – Product data representation and exchange – Part 43: Integrated generic resource: Representation structure*.
ISO 10303-44: [1)], *Industrial automation systems and integration – Product data representation and exchange – Part 44: Integrated generic resource: Product structure configuration*.
ISO 10303-105: 1996, *Industrial automation systems and integration – Product data representation and exchange – Part 105: Integrated application resource: Kinematics*.
ISO/CD 10303-108: [1)], *Industrial automation systems and integration – Product data representation and exchange – Part 108: Integrated application resource: Parametrization and constraints for explicit geometric models.*

# 3. Definitions

## 3.1 Terms defined in ISO 10303-1

This part of ISO 10303 makes use of the following terms in ISO 10303-1.

- **Component**: a product that is not subject to decomposition from the perspective of a specific application.

## 3.2 Other definitions

For the purpose of this part of ISO 10303, the following definitions apply.

**3.2.1 feature**: an element to specify the properties of the components.

**3.2.1 feature association**: an association between a pair of the features of the components.

## 3.3 Abbreviations

For the purpose of this part of ISO 10303, following abbreviations apply:

 

| | |
|---|---|
| AM | application module |
| ARM | application reference model |
| MIM | module interpreted model |
| UoF | unit of functionality |
| URL | uniform resource locator |

# 4. Information requirements

This clause specifies the information requirements for the assembly feature module. The information requirements are specified as a set of units of functionality and application objects. The information requirements are defined using the terminology of the subject area of this application module.

NOTE 1 – A graphical representation of the information requirements is given in annex C.

NOTE 2 – The mapping specification is specified in 5.1 which shows how the information requirements are met using the integrated resources of this International Standard. The use of the integrated resources introduces additional requirements which are common to application modules and protocols.

**EXPRESS specification:**

```
*)
SCHEMA feature_arm;
(*
```

## 4.1 Units of functionality

This subclause specifies the unit of functionality (UoF) for this part of ISO 10303. This part of ISO 10303 specifies the following units of functionality:

The unit of functionality and a description of the functions that each UoF supports are given below. The application elements included in the UoFs are defined in clause 4.3.

### 4.1.1 feature

The feature UoF specifies the definitional information for the overall concept of features.

The following application entities are specified in the feature UoF:

- feature_definition
- instanced_feature
- feature_association

### 4.2 ARM entity defintions

This subclause specifies the application entities for the feature and their association. Each application entity is an atomic element that embodies a unique application concept and contains attributes specifying the data elements of the entity. The application entities and their definitions are given in below.

#### 4.2.1 feature_definition

A **feature_definition** is a set of parameters and type information representing a feature. This entity defines the templates or the catalogues of the features.

*EXPRESS* specification:

```
*)
ENTITY feature_definition
  ABSTRACT SUPERTYPE;
END_ENTITY; --feature_definition
(*
```

#### 4.2.2 instanced_feature

An **instanced_feature** is the identification of a feature which is a potion of a **product_definition**. This entity is a subtype of the **feature_definition**.

*EXPRESS* specification:

```
*)
ENTITY instanced_feature
SUBTYPE OF (feature_definition);
END_ENTITY; --instanced_feature
(*
```

#### 4.2.3 feature_association

A **feature_association** represents the associations between pairs of **instanced_features** from the viewpoint of the application fields of the product model. The **feature_associations** are the key elements for describing the associations between a pair of the features.

 

*EXPRESS* specification:

```
*)
ENTITY feature_association
  ABSTRACT SUPERTYPE;
  id: identifier;
  relating_feature: instanced_feature;
  related_feature: instanced_feature;
UNIQUE
  UR1: id,
       relating_feature,
       related_feature;
WHERE
  WR1: relating_feature :<>: related_feature;
END_ENTITY; --feature_association
(*
```

**Attribute definitions:**
**id:** identification of this association.
**relating_feature**: one of the **instanced_feature** which is a part of relationship.
**related_feature**: the other **instance_feature** which is a part of relationship. If one element of the relationship depends upon the other, this attribute shall be the dependent one.

**Formal propositions:**
UR1: The **id**, **relating_feature** and **related_feature** uniquely identify an instance of **feature_association**.
WR1: two of the **instanced_feature**s associated by this entity shall be different instances.

*EXPRESS* specification:

```
*)
END_SCHAME
(*
```

# 5. Module interpreted model

## 5.1 Mapping specification

This clause contains the mapping table that shows how each UoF and application elements of this part of ISO 10303 (see 4.1) mapped to one or several MIM resource constructs. The mapping table is organized five columns. The contents of these five columns are:

Columns 1) Application element: Name of an application element as it appears in the application entity

 

definition. Application entity names are written in upper case. Attribute names are listed after the application entity to which they belong and are written in lower case.

Column 2) MIM element: Name of an MIM element as it appears in the MIM, the term 'IDENTICAL MAPPING', or the term 'PATH'. MIM entities are written in lower case. Attribute names of MIM entities are referred to as <entity name>, <attribute name>. The mapping of an application element may result in several related MIM elements. Each of these MIM elements will require a line of its own in the table. The term 'IDENTICAL_MAPPING' indicates that the both application entities of an application assertion map to same MIM element. The term 'PATH' indicates that the application assertion maps to the entire reference path.

Column 3) Source: For these MIM elements that are interpreted from the integrated resources, that is the number of the corresponding part of ISO 10303. For those MIM elements that are created for the purpose of this part of ISO, this is the number of this part.

Column 4) Rules: One or more numbers may be given which refer to rules that apply to the current MIM element or reference path. For rules that are derived from relationships between application entities, the same rule is referred to by the mapping entries of all the involved MIM elements. The expanded named of the rules are listed after the table.

Column 5) Reference path: To describe fully the mapping of an application entity, it may be necessary to specify a reference path through several related MIM elements. The reference path column documents the role of a MIM element relative to the MIM element in the row succeeding it. Two or more such related MIM elements define the interpretation of the integrated resources that satisfies the requirement specified by the application entity. For each MIM element that has been created for use within this part of ISO 10303, a reference path up to its supertype from an integrated resource is specified.

For the expression of reference paths and the relationships between MIM elements, the following notational conversions apply:

[]: multiple MIM elements or sections of the reference path are required to satisfy an information requirement;

(): multiple MIM elements or sections of the reference path are identical as alternatives with in the mapping to satisfy an information requirement;

{}: enclosed section contains the reference path to satisfy an information requirement;

->: attribute references the entity or select type to satisfy an information requirement;

<-: entity or select type in referenced by the attribute in the following row;

[i]: attribute is an aggregation of which a single member n is given in the following row;

 

=>: entity is an supertype of the entity given in the following row;

<=: entity is an subtype of the entity given in the following row;

=: the string, select or enumeration type in constrained to a choice or value;

\: the line continuation for strings that wrap;

 

Table 1 Mapping table for feature UoF

| Application element | MIM element | Source | Rules | Reference path |
|---|---|---|---|---|
| FEATURE_DEFINTION | feature_definition | 41 | | characterized_object => feature_definition |
| INSTANCED_FEATURE | instanced_-feature | 41 | | characterized_object => feature_definiton => instanced_feature <= shape_aspect |
| FEATURE_ASSOCIATION | feature_-association | 41 | | shape_aspect_relationship => feature_association |
| id | PATH | | | shape_aspect_relationship.name |
| relating_feature | PATH | | | shape_aspect_-relationship.relating_shape_aspect |
| related_feature | PATH | | | shape_aspect_-relationship.related_shape_aspect |

## 5.2 MIM EXPRESS short listing

This clause specifies the EXPRESS schema that uses elements from the integrated resources, application interpreted constructs or application module MIMs and constraints the types, entity specializations, rules and functions that are specific to this part of ISO 10303. This clause also specified modifications to the textual material for constructs that are imported from the integrated resources. The definitions and EXPRESS provided in the integrated resources or application interpreted constructs for constructs used in the MIM. Requirements stated in the integrated resources or application interpreted constructs which refer to such items and subtypes apply exclusively to those items which are imported into the MIM.

*EXPRESS* specification:

```
*)
SCHEMA  feature_mim;

USE FROM product_property_definition_schema
  ( characterized_object,
    shape_aspect,
    shape_aspect_relationship);
(*
```

NOTE 1 – See Annex D for a graphical presentation of this schema using EXPRESS-G notations.

NOTE 2– The schemas referenced above can be found in the following parts of ISO 10303:

| | |
|---|---|
| product_property_definition_schema | ISO 10303-41 |

### 5.2.1 Module entity definition

This subclause contains the EXPRESS entity definitions in this part of ISO 10303.

#### 5.2.1.1 feature_definition

A **feature_definition** is a subtype of the **characterized_object**, which represents a set of parameters and type information representing a feature. This entity defines the templates or the catalogues of the features

*EXPRESS* specification:

```
*)
ENTITY feature_definition
  SUBTYPE OF ( characterized_object);
END_ENTITY; --feature_definition
(*
```

 

### 5.2.1.3 instanced_feature

A **instanced_feature** is a subtype of the **feature_definition** and the **shape_aspect**. This entity represents the identification of a feature, which is a potion of a **product_definition**
.

*EXPRESS* specification:

```
*)
ENTITY instanced_feature
  SUBTYPE OF (feature_definition, shape_aspect);
END_ENTITY; --instanced_feature
(*
```

### 5.2.1.3 feature_association

A **feature_association** represents the associations between pairs of **instanced_features** from the viewpoint of the application fields o f the product model. The **feature_association**s are the key elements for describing the associations between a pair of the features.

```
ENTITY feature_association
  SUBTYPE OF ( shape_aspect_relationship );
  SELF\shape_aspect_relationship.relating_shape_aspect: instanced_feature;
  SELF\shape_aspect_relationship.related_shape_aspect: instanced_feature;
UNIQUE
  UR1: SELF\shape_aspect_relationship.name,
       SELF\shape_aspect_relationship.relating_shape_aspect,
       SELF\shape_aspect_relationship.related_shape_aspect;
WHERE
  WR1: relating_shape_aspect :<>: related_shape_aspect;
END_ENTITY; --assembly_feature_association
(*
```

**Attribute definitions:**
**relating_shape_aspect**: one of the **instanced_feture** which is a part of relationship.
**related_shape_aspect**: the other **instanced_feture** which is a part of relationship. If one element of the relationship depends upon the other, this attribute shall be the dependent one.

**Formal propositions:**
UR1: The **name**, **relating_shape_aspect** and **related_shape_aspect** uniquely identify an instance of **feature_association**.
WR1: two of the **instanced_feature**s associated by this entity shall be different instances.

*EXPRESS* specification:

```
*)
END_SCHEMA;
(*
```

# Annex A

# (normative)

# MIM short names

Entity names in this part of ISO 10303 have been defined in other parts of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303. The EXPRESS MIM short names are available from the Internet:

<http;//www.mel.nist.gov/**********>

# Annex B

(normative)

Information object registration

## B1. Document identification

To provide for unambiguous identification of an information object in an open system, the object identifier

{iso standard ISO 10303 part (10xx) version (-1)}

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

## B2. Schema identification

To provide for unambiguous identification of the schema specification given in this application module in an open information system, the object identifiers are assigned as follows:

{ iso standard 10303 part (10xx) version (0) object(1) feature-arm-schema(1) }

is assigned to the feature_arm schama.

{ iso standard 10303 part (10xx) version (0) object(2) feature-mim-schema(1) }

is assigned to the feature_mim_schema short form schema (see 5.2). The meaning of this value is identified in ISO/IEC 8824-1, and is described in ISO 10303-1.

# Annex C

# (informative)

# ARM EXPRESS-G

The following diagrams correspond to the ARM EXPRESS listing given in clause 4. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex D of ISO 10303-11.

NOTE – The inter-page referencing is to the diagram number and not the figure number.

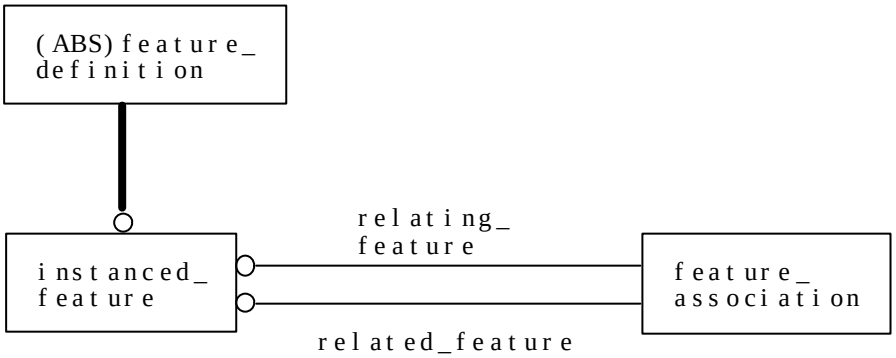


Figure C-1 Feature ARM

# Annex D

# (informative)

# MIM EXPRESS-G

The following diagrams correspond to the MIM EXPRESS listing given in clause 4. The diagrams use the EXPRESS-G graphical notation for the EXPRESS language. EXPRESS-G is defined in annex D of ISO 10303-11.

NOTE – The inter-page referencing is to the diagram number and not the figure number.

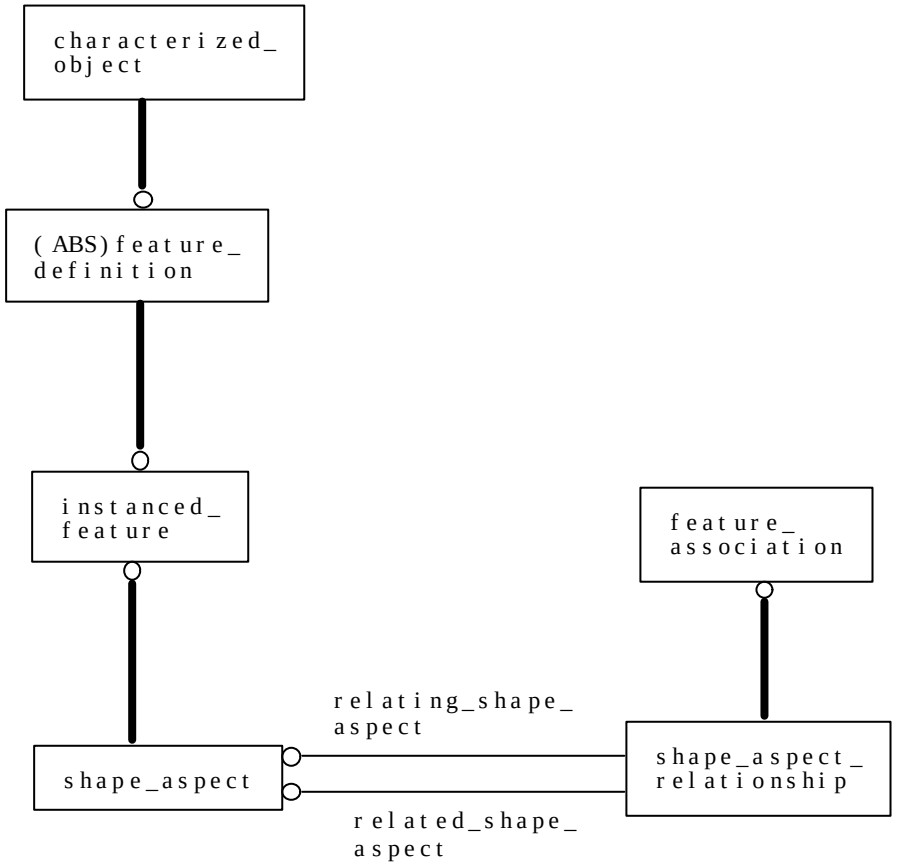


**Figure D-1 Feature MIM**

# Annex E

# (informative)

# AM ARM and MIM EXPRESS

This annex provides a listing of the EXPRESS for the ARM specified in clause 4 and EXPRESS schema specified in 5.2 of this part of ISO 10303 without comments or other explanatory text. The content of this annex is available in computer-interpretable form and can be found at the following URLs:

<http://www.nist.gov/sc4/nwi/step/part10xx/feature_arm.exp>

<http://www.nist.gov/sc4/nwi/step/part10xx/feature_mim.exp>

# Index

## (to be completed)